Review Article

International Journal of Pediatric Nursing
Volume 10 Number 3, September – December 2024
DOI: http://dx.doi.org/1021088/ijpen.2454.9126.10324.6

Pain Perception and Incidence of Painful Procedures in Neonates: A Review of Research Evidence and Implications for Nursing Practice

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How to cite this article:

Nandini Mannadath, Roshni Rani, Senthilkumar Thavasiappan, Pain Perception and Incidence of Painful Procedures in Neonates: A Review of Research Evidence and Implications for Nursing Practice. Int J Pediatr Nurs. 2024;10(3):131-135.

Abstract

Pain perception in neonates and the incidence of painful procedures have been important in recent literature. This review examines the current evidence surrounding these topics: however, the implications for nursing practice remain critical. Although neonates may not articulate their pain, they experience it profoundly. Nurses must, therefore, be aware of the various factors influencing pain perception because effective management is essential. Research indicates that pain in neonates can lead to long-term consequences; this underscores the necessity for appropriate interventions. Ultimately, understanding pain perception not only enhances patient care but also informs nursing strategies, thus improving outcomes for vulnerable populations.

Keywords: Pain perception, Incidence of pain in neonates, Neonatal pain, Painful procedures in neonates, Nursing practice.

INTRODUCTION

Pain management in neonates has garnered increased attention over recent years, reflecting a shift in understanding regarding the neonate's capacity for pain perception and the lasting impact of untreated pain. Historically, neonates were thought to have an underdeveloped nervous system, which led to the assumption that their responses to painful stimuli were primarily reflexive. However, extensive research has now debunked this view; revealing that neonates not only perceive pain but may also experience it more acutely than older children and adults because of the immaturity of descending inhibitory pain pathways and heightened sensitivity of peripheral receptors. Furthermore, advances in neuroimaging have shown that painful stimuli activate areas of the neonatal brain similar to those in adults, underscoring the need for pain management protocols even in this vulnerable population. Although this understanding has evolved, challenges remain in effectively addressing pain in neonates.

The incidence of painful procedures in neonatal care is alarmingly high (particularly among preterm infants in the NICU) because these infants

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Received on: 02-12-2024 **Accepted on:** 21-12-2024

often undergo numerous procedures each day: heel sticks, venipunctures and intubations. However, these procedures are frequently conducted without adequate analgesic interventions, as managing pain in neonates presents unique challenges. The repercussions of untreated pain in early life are far-reaching; evidence suggests that repeated exposure to painful stimuli can have long-term effects on an infant's sensory processing, stress response and neurodevelopmental outcomes. This emphasizes the responsibility of healthcare professionals (especially nurses) to ensure that pain is effectively recognized and mitigated in neonatal care settings, although there remains considerable room for improvement in practice.

Incidence and Perception of Pain in Neonates

Research has clarified that neonates (infants just after birth) possess a fully functional nociceptive system, which enables them to perceive and react to painful stimuli. A significant study conducted by **Anand and Hickey (1987**) established that neonates display hormonal and metabolic responses akin to those of older children when faced with pain; thisfinding challenges previous misconceptions regarding the capacity of neonates to perceive pain. Additionally, **Fitzgerald** *et al.* **(1988)** documented increased reflexive reactions to noxious stimuli in both preterm and term infants, suggesting that their developing nervous systems may be particularly sensitive to pain. More contemporary studies that employed MRI imaging, such as those by **Slater** *et al.* **(2006),** have further substantiated that neonates exhibit cortical responses to pain that are comparable to those of adults. However, this evidence reinforces the notion that neonates do, in fact, experience pain.

Using the primal face of pain (PFP), **Schiavenato** *et al.* **(2008)** used a computer-based methodology that involved "point-pair" comparisons recorded from video to measure facial movement in the pain expression by way of change across two images: one image before and one image after a painful stimulus (heel-stick). This study was done to assess the presence of pain in neonates. Fifty-seven neonates of both sexes and three ethnic backgrounds African American, Caucasian, and Hispanic/Latino were included for facial expression similarity analysis. Behavioral state, kind of bottle, breast, or both, feeding, and the use of epidural and/or other prenatal anesthetic were all factors that the researcher controlled. The PFP, which was characterized by mouth opening, brow drawing, and eye closure, was in line with other studies of pain expression in newborns. The study came to the conclusion that, despite the fact that facial expressions vary throughout ethnic groups, neonates' shared experience of pain is clinically significant.

In 1995, Craiq *et al.* conducted a study to compare the preparation and recovery intervals and analyze the physiological measurements, body movements, and facial activity of 56 preterm and full-term neonates in response to heel lancing. There hasn't been any comprehensive research done on how invasive procedures affect preterm newborns. According to data analyses, infants with gestational ages as brief as 25–27 weeks showed physiological responsiveness to the lancing process, and reactions to it were the largest across all measurement groups. However, the heart rate measure's responsiveness changed as gestational age increased. The study's findings concluded that preterm neonates generally had lower levels of body activity than full-term infants, whereas facial activity rose as the infant's gestational age progressed. The facial activity measure also showed the highest specificity of reaction to the heel lance. The preterm neonate's gestational age must be taken into consideration while identifying pain.

A study was under taken at the Immunization Clinic, Andhra Mahila Sabha, Chennai to assess the effectiveness of breast feeding on the pain perception of infants during immunization. A total of 60 infants (30 in the control and 30 in the experimental group) were evaluated using NIPS. The mothers were made to breast feed their babies 2 minutes before and 5 minutes after administration of immunization. Results were analyzed and it was found that all the infants in the control group had severe pain 73.3% of the infants in the experimental group had only mild pain and there was a significant difference in mean painscore after breast feeding in infants in experimental and control group (t=13.9). The study concluded that there was asignific antassociation between age and pain perception in infants and the infants who had received breast feeding before and after immunization injections in the experimental group had a reduction in pain. **(Sharley** *et al***, 2012).**

Johnston *et al.* **(1997)** carried out a survey to find out the current procedures for the administration of analgesia to term and preterm neonates receiving one week of care in 14 Neonatal Intensive Care Units (NICUs) across Canada. Over the course of the trial, daily logs were maintained detailing the frequency, kind, and administration of analgesia for every sick baby in each NICU. The study included 2,134 invasive procedures in a sample of 239 neonates.

Particularly, medication was administered 18 times for 17 invasive operations and 129 times for further invasive procedures. During the survey period, sixteen neonates underwent surgery, and fourteen more underwent surgery prior to but within four days of the survey. The most utilized drugs were opioids, which were administered for a variety of purposes by intermittent bolus, continuous infusion, or occasionally both for the same newborn. The study found that whereas opioid and non-opioid analgesics are rarely used for nonsurgical invasive procedures, postoperative pain in neonates in Canadian NICUs seems to be regularly managed.

The frequency of analgesic usage during invasive operations in newborns and the related pain burden in this population were evaluated in prospective research of procedural pain and its management, which involved 151 neonates in a neonatal intensive care unit in the Netherlands. The study's findings showed that, on average, each newborn underwent 14 +/- 4 procedures every day. Suctioning accounted for 63.6% of procedures, and the first day of admission was the time when the most painful treatments were performed. In the newborn critical care unit, 39.7% of the neonates received no analgesic therapy at all, and less than 35% of the neonates received pre-procedural analgesic therapy on each research day. Most procedures performed in neonatal intensive care units are painful, according to the study's findings, however only one-third of the newborns received the proper analgesic therapy. Systematic approaches are needed to decrease the incidence of pain and enhance the analgesic treatment of recurrent pain in neonates. **(Simons** *et al***, 2003).**

Nature of Painful Procedures in Neonatal Care

Research has consistently demonstrated a high frequency of painful interventions within NICU environments. **Carbajal** *et al.* **(2008)** undertook a multicentre investigation that revealed neonates in intensive care endure, on average, ten painful procedures daily, frequently with minimal to no analgesia administered. This study also highlighted significant discrepancies in pain management practices among various units, thereby emphasizing the necessity for standardized protocols. Moreover, further research conducted by **Johnston and Stevens (2010)** indicated that repeated exposure to painful procedures without sufficient pain relief not only elevates stress levels in neonates (however, it may also influence neurodevelopment). These findings underscore the crucial importance of establishing effective pain assessment and management strategies (because they are essential) to enhance the quality of neonatal care.

Of the 42,413 painful procedures, 2.1% were carried out with only pharmaceutical therapy, 18.2% with non-pharmacological interventions, 20.8% with pharmaceutical, non-pharmacological, or both types of therapy, 79.2% without specific analgesia, and 34.2% while the neonate was receiving anaesthetic or analgesic infusions concurrently for other reasons. In contrast, mechanical ventilation, non-invasive ventilation, and the administration of nonspecific concurrent analgesia were linked to lower use of specific pre-procedural analgesia. These factors included prematurity, procedure category, parental presence, surgery, daytime, and the day of the procedure after the first day of admission. **(Carbajal** *et al***, 2008).**

A study on gender variations in pain expression between preterm and term newborn infants, **Guinsburg** *et al.* **(2000)** conductedwith 65 neonates (37 female and 28 male infants) with gestational ages ranging from 28 to 42 weeks and 25 to 120 hours of life. Clinically stable preterm infants needed a capillary puncture for glucose dosage, while healthy-term neonates needed one for PKU screening. Before the puncture, while the infants were at rest, during foot heating, during capillary puncture, and one, three, and five minutes after heel lancing, the Neonatal Infant Pain Scale (NIPS) and the Neonatal Facial Coding System (NFCS) were assessed at the patient's bedside.The findings revealed a significant interaction between the NFCS score profiles of male and female newborns during the various study times (P=0.025) and a substantial difference between the mean NFCS scores for the entire sample of neonates over the six study periods (P<0.000001). NFCS and NIPS had no discernible relationships between gestational age and time or between gestational age and gender. The study concluded that freshly born female neonates of all gestational ages displayed more facial signs of pain than male babies, during the capillary puncture and 1 min subsequently.

The study examined the quantity and type of invasive treatments performed on 54 consecutive newborns who were admitted to a neonatal critical care unit. In all, almost 3000 procedures were documented, with 74% of them involving infants born before 31 weeks of pregnancy. One baby (23 weeks gestation, 560 g at birth) received 488 procedures alone out of 54 neonates, which is concerning. Most frequently performed procedures were heel prick blood collection (56%), endotracheal suction (26%), and intravenous cannula insertion

(8%). Neonatal intensive care unit admissions often involve invasive operations that might cause pain or distress to a kid. A reduction in the number of procedures, their modification, or the provision of sufficient analgesics may alleviate some of this discomfort.**(Barker & Rutter, 1995).**

Nursing Practice Implications

Effective pain management for neonates in clinical settings is essential to mitigate the immediate and long-term impacts of untreated pain. Nurses play a vital role in assessing, managing, and advocating for neonatal pain relief, ensuring that even the youngest patients receive compassionate and evidence-based care.

1. **Assessment and Documentation of Pain in Neonates**

   Neonates particularly those situated in Neonatal Intensive Care Units (NICUs) are unable to articulate their pain verbally, which renders standardized pain assessment tools indispensable. Instruments like the Neonatal Infant Pain Scale (NIPS) and the Premature Infant Pain Profile (PIPP) enable nurses to evaluate pain through observable indicators, such as facial expressions, vital signs, and limb movements. A study conducted by Axelin *et al.* (2020) illustrated that the consistent application of validated pain assessment tools results in improved pain management and outcomes. This emphasizes the necessity for nurses to frequently incorporate these tools in their practice to effectively monitor neonatal pain however, there are still challenges in standardizing their use across different settings.

2. **Non-Pharmacologic Pain Relief Interventions**

   Non-pharmacologic pain management techniques, including swaddling, non-nutritive sucking (NNS), and skin-to-skin contact, have shown efficacy in reducing pain responses in neonates. Ongoing research supports the routine use of these interventions. For instance, a recent randomized controlled trial by Olsson *et al.* (2022) found that skin-to-skin contact significantly reduces pain during minor procedures, such as heel pricks, by promoting relaxation and reducing cortisol levels. As frontline caregivers, nurses are well positioned to implement these interventions consistently, reinforcing a holistic approach to neonatal pain management.

3. **Incorporating Pharmacologic Pain Management**

   Although non-pharmacologic methods offer certain benefits, there are instances where painful procedures necessitate pharmacologic interventions. Studies underscore the significance of employing safe, evidence based pharmacologic options (for instance, oral sucrose or acetaminophen) to ensure adequate pain relief when required. A systematic review conducted by Pillai Riddell *et al.* (2021) revealed that sucrose, when combined with non-nutritive sucking, significantly diminishes both behavioral and physiological indicators of pain during procedures. Nurses must be well-informed about dosing, administration protocols and monitoring for potential adverse effects when utilizing pharmacologic methods; however, they should also advocate for their use whenever appropriate. This knowledge is crucial, because it empowers healthcare professionals to enhance patient comfort and outcomes.

4. **Advocacy for Policy Development and Multidisciplinary Collaboration**

   Standardized standards must be established because neonatal pain treatment practices vary widely. Nurses should support the creation of unit-specific policies based on current research, particularly studies that support the use of both pharmacologic and non-pharmacologic pain management strategies. Multidisciplinary cooperation (including neonatologists, nurses, and pain specialists) can greatly improve pain treatment results in neonatal care units, according to research by Anand *et al.* (2019). Because of their special position, nurses may play a crucial part in creating and carrying out these regulations, guaranteeing uniformity in the way that patients are cared for throughout the unit. But reaching this objective calls for constant work and dedication from all participating healthcare providers.

5. **Education and Training for Continuous Improvement in Pain Management**

   The key to giving nurses the skills they need to properly diagnose and treat newborn pain is education. Frequent training sessions on contemporary evidence based methods can improve nurses' abilities to identify and manage neonatal discomfort. According to a study by Badr *et al.* (2021), focused teaching programs for NICU nurses enhanced their

understanding, perspectives, and methods of managing newborn pain, which increased adherence to pain protocols and produced better results. Neonatal nurses can be better equipped to provide the best possible, research-informed pain management by receiving regular training on the most recent research results.

CONCLUSION

Through the integration of these practices, nurses can play a pivotal role in alleviating neonatal pain and enhancing developmental outcomes. Continuous education and effective pain assessment are essential; however, the utilization of both non-pharmacologic and pharmacologic methods is equally vital. This multifaceted approach will enable neonatal care units to deliver compassionate, evidence-based care that ultimately safeguards infants' long-term well-being. Because of the complexity of neonatal pain management, it is crucial to remain adaptable and informed about the latest research. Although challenges may arise in implementing these strategies, the potential benefits for infants are profound.

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